

Digestive & Metabolism

**Dr. Alaa Kamal Jabbar
Alhamd
M Sc. & Ph. D. In
Clinical Biochemistry**

Ph D. Course -Biology
Department of Chemistry
**College of Sciences\ University of
Almustansirya**

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Digestive & Metabolism

➤ **Digestion** - mechanical & chemical breakdown of food into nutrients

➤ **Metabolism** - chemical reactions breaking down food and releasing energy from nutrients

➤ Key features among vertebrates influencing their digestive system are jaws and teeth.

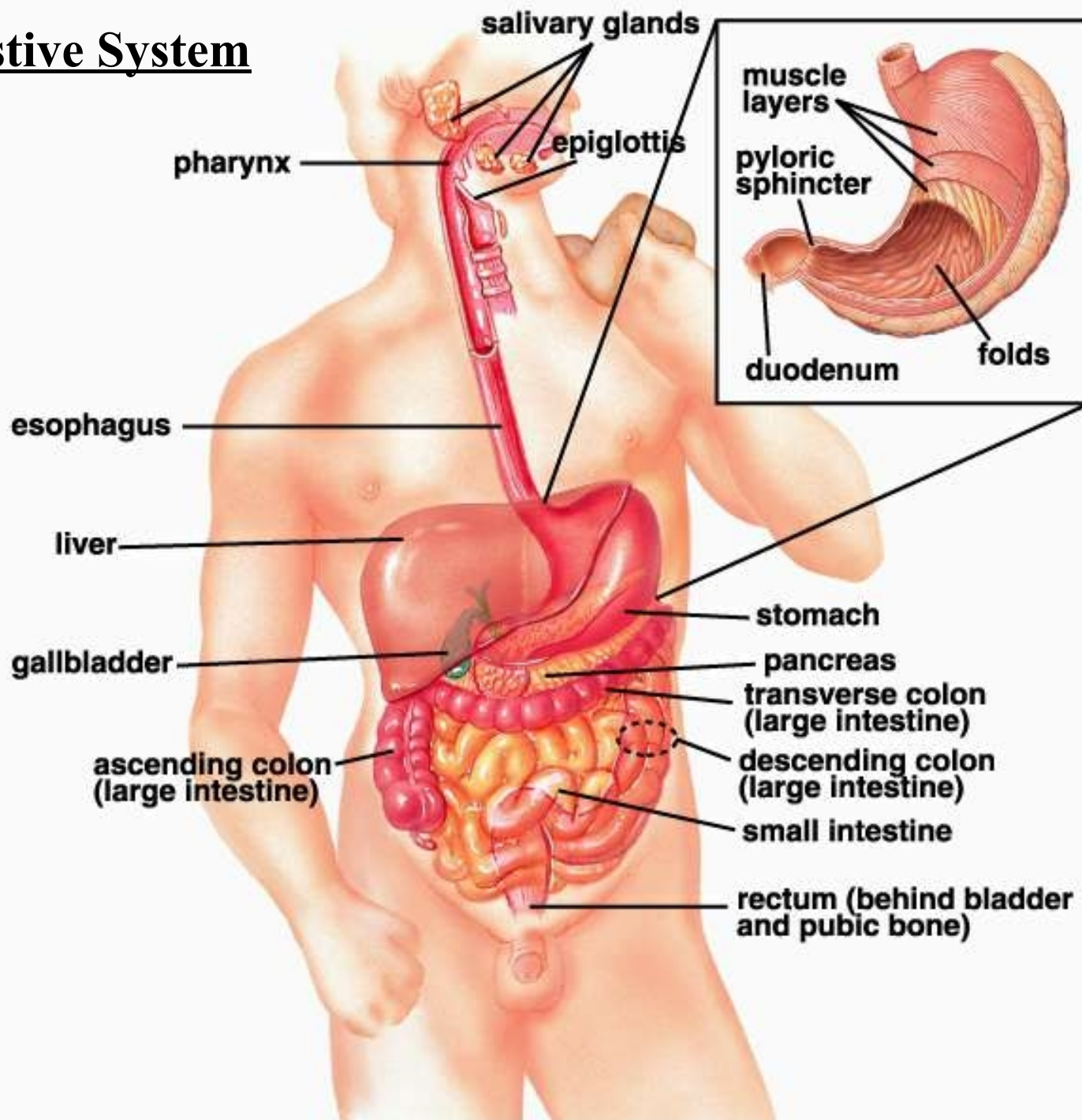
➤ Both are important for holding and tearing food.

➤ Teeth shape is a good clue to a vertebrates diet.

Mammals such as humans

- Teeth in sockets
- Milk teeth
- Permanent teeth
 - incisors - cutting & gnawing
 - canines - tearing food
 - molars & premolars - grinding & shearing

Digestive System



Human Digestive System

- 1. Lips & tongue
 - saliva & salivary amylase
 - **pharynx** - divides into larynx & laryngopharynx
 - Swallowing- tongue pushes food into **bolus**
 - **peristalsis** moves food down esophagus
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- Stomach -
 - food enters via cardiac sphincter
 - stores food
 - begins digestion
 - kills microorganisms.
 - muscle layers create churning motion

Stomach lining

➤ glands secrete gastric juice

➤ chief cells - secrete pepsinogen

➤ parietal cells - produce hydrochloric acid (HCL).

➤ HCL changes pepsinogen to pepsin

➤ Stomach also secretes **gastric lipase** ,
(enzyme starts fat digestion).

➤ **Chyme** passes through pyloric sphincter into duodenum.

➤ **Small Intestine**

Receives chyme into duodenum.

- Receives products of liver & pancreas
- Jejunum
- Ileum

Accessory Organs

1. **Liver** - secretes bile that emulsifies fat. Bile is stored in the gall bladder and enters the small intestine via the bile duct.
2. **Pancreas** - produces sodium bicarbonate (to neutralize stomach acids) + variety of digestive enzymes to breakdown fat, protein, carbohydrate, nucleic acids.

➤ **Large intestine (colon or bowel)**

- Cecum, joins to small intestine on the right side of the body; at one way valve called the ileocecal valve. The cecum is a blind pouch; vestigial projection called appendix found here.
- Colon absorbs water & minerals into blood and prepares feces to leave the body; little digestion occurs here but food residues are digested by bacteria- important role in nutrition by absorbing nutrients/vitamins such as vitamin K..

Chemistry of Digestion

Hydrolysis digests foods:

1. Carbohydrates (starches) - become simple sugars
2. Proteins - become amino acids
3. Fats - become fatty acids & glycerol
4. Nucleic acids (RNA, DNA) - become nucleotides

Begins in mouth - salivary amylase breaks down starch

Carbohydrate Digestion

Stalled in the stomach Mostly occurs in small intestine aided by following enzymes:

- a. Pancreatic enzymes - breaks starch into maltose
- b. Maltase - breaks maltose into 2 glucoses
- c. Sucrase - breaks sucrose into 1 glucose and 1 fructose
- d. Lactase - breaks lactose into 1 glucose + 1 galactose

Last 3 enzymes produced by small intestine. Following absorption, glucose, fructose, & galactose transported to the liver where they are converted to glycogen.

➤ **Fat Digestion**

Gastric lipase of stomach breaks down some fats.

Most fat digestion occurs in small intestine.

bile emulsifies fat, exposing more fat to enzymes.

Bile salts link fat molecules to water molecules; (normally fats are hydrophobic).

Pancreatic lipases continues fat digestion

subunits now cross into microvilli

subunits are reassembled into triglycerides, combined with cholesterol, and transported to the circulatory system

Protein Digestion

1. Stomach - pepsinogen converted to **pepsin** in the presence of HCL. Pepsin breaks some of the peptide bonds of some proteins.
2. Small intestine - Pancreatic enzymes trypsin & chymotrypsin break proteins into smaller and smaller units. The pancreatic enzyme carboxypeptidase breaks peptides into free amino acids. Several enzymes produced by the small intestine further break peptides into amino acids.

- Amino acids- absorbed and transported to the liver.
 - used directly by the liver to make liver proteins
 - others converted to acetyl coenzyme A (used in citric acid cycle) other amino acids sent to various parts of the body for protein synthesis.

- Proteases must be activated before being used Prevents them from breaking down pancreas (where they're made & stored).
 - Activation occurs when they come in contact w/ certain chemicals found in the small intestine.

Nucleic Acid Digestion

Enzymes called nucleases break down nucleic acids such as RNA (ribonucleic acid) and DNA (deoxyribonucleic acid) into nucleotide chains.

1. The pancreas produces ribonuclease and deoxyribonuclease
2. small intestine produces nucleases that break down nucleotides into smaller subunits.

Integration & Regulation of Digestive Processes

1. **Mechanical** - act of chewing causes release of salivary amylase.
2. **Neural** - food in stomach stimulates vagus nerve, signal sent to brain, brain sends another signal down vagus nerve for stomach to release gastric secretions.
3. **Hormonal** - e.g. the stomach releases the hormone gastrin when a protein concentration is detected; gastrin circulates in blood, target cells are gastric glands which release gastric enzymes; similar in small intestine and pancreas.

Elements of Nutrition

1. provides food for fuel
2. provides food for fabrication
3. provides food to obtain essential nutrients, water, minerals